

6 – East Central Indiana Exceptional Events Detail

Parameter:	PM _{2.5}
Dates:	May 23-25, 29-31, 2007
Location:	Anderson / Muncie / Mechanicsburg – Madison / Delaware / Henry Co.
Event:	Smoke from wildfires in northern Florida and southern Georgia impacted the East Central Indiana region during the period of May 23-25 and 29 - 31, 2007. The gradual buildup of smoke moving through the area during this period resulted in an exceedance of the 24-hour PM _{2.5} NAAQS on May 23 rd at Anderson (18-095-0009) and May 23 rd and 29 th at Muncie (18-035-0006) in addition to several elevated readings throughout the region.
Data:	<p>Different analyses of the data are used to demonstrate that the PM_{2.5} concentrations measured from May 23 – 31 are beyond the range of values typically found during that time period and that they have been influenced by outside events. Table 6.1 shows daily PM_{2.5} averages prior to, during and after the event with the values flagged in bold. Data have been flagged with an exceptional event flag of 'E' in AQS, awaiting concurrence from EPA.</p> <p>Tables 6.2 and 6.3 list summaries of the data collected at all three sites since 2000. Data from 2007 are calculated with all current data and with the flagged data removed. There is a significant improvement in both the 98th percentile and annual average values at all three sites.</p>

**Table 6.1 - FRM Daily Values
Exceptional Event Period**

Values in **BOLD** are flagged as exceptional events

Date	Anderson - 5th St. 18-095-0009	Muncie Central 18-035-0006	Shenandoah HS/ Mechanicsburg 18-065-0003
5/17/07	4.3	3.7	
5/18/07	6.5	5.5	4.9
5/19/07	11	10	
5/20/07	14		
5/21/07	16.2		14.6
5/22/07	19.5		
5/23/07	36.4	36	
5/24/07	29.4	31.4	30.7
5/25/07	30.2	30.7	
5/26/07	24.8	24.7	
5/27/07	24.5	22.4	21.5
5/28/07	22.8	21.3	
5/29/07	38	35.1	
5/30/07	32.9	33.4	32.4
5/31/07	32.6	30.2	
6/1/07	28.5	24.6	
6/2/07	19.1	19.4	
6/3/07	19.7	23.5	

Table 6.2 - Historical Daily Values

		Anderson 180950009		Muncie 180350006		Mechanicsburg 180650003	
Year		98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹	98th %ile	Daily Design Value ¹
2000		33.1		34.8			
2001		36.8		35.7		30.7	
2002	2000- 2002	34.2	35	30	34	29.7	27
2003	2001- 2003	35.5	36	36.5	34	31.4	31
2004	2002- 2004	28.2	33	27.2	31	26.9	29
2005	2003- 2005	38.3	34	37.3	34	37.3	32
2006	2004- 2006	28	32	27.4	31	27.2	30
2007	2005- 2007	34.3	34	32.9	33	32.4	32
		Values excluding flagged data					
2007	2005- 2007	30.9	32	29.1	31	28.9	31

¹Daily Design Value = 3 year average of annual 98th %ile values.

Table 6.3 - Historical Annual Averages

		Anderson 180950009		Muncie 180350006		Mechanicsburg 180650003	
Year		Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²	Annual Ave.	Annual Design Value ²
2000		15.5		16.2			
2001		14.6		14.5		13.6	
2002	2000- 2002	14.9	15	14.5	15.1	13.7	13.4
2003	2001- 2003	14.3	14.6	14	14.3	13.4	13.6
2004	2002- 2004	12.8	14	12.3	13.6	11.9	13
2005	2003- 2005	16.1	14.4	16.4	14.2	15.7	13.6
2006	2004- 2006	12.1	13.6	11.9	13.5	11.1	12.9
2007	2005- 2007	13.7	13.9	13.3	13.9	13.1	13.3
		Values excluding flagged data					
2007	2005- 2007	13.4	13.8	12.9	13.7	12.8	13.2

²Annual Design value = 3 year average of the annual averages.

Particulate

Composition: Speciation data are collected at the Mechanicsburg site on a one in six day sampling schedule. Data are available for May 24 and May 30. High organic carbon values were reported on those two dates; 7.0 ug/m³ and 7.2 ug/m³ respectively. These values were the highest and the second highest values of the year. They were also more than twice the annual average of 3.06 ug/m³ for organic carbon at this site. There was only a slight increase in the elemental carbon values; 0.5 ug/m³ and 0.6 ug/m³, on the two dates, as compared to the annual average of 0.45 ug/m³. Appendix 3 details the rise and fall of the regional organic carbon values through mapping.

Maps: Images of maps from NOAA Satellite and Information Services show the smoke plume originating from the northern Florida/southern Georgia region. Dispersion and movement of the smoke plume from these fires was generally to the west or northwest and then to the north. The daily satellite smoke photos show that the smoke plume from the fires comes into southern Indiana on May 23 and continues to influence the atmosphere sporadically until June 2. Daily wind roses (obtained from the meteorological site at Shenandoah HS, 18-065-0003) show information on prevailing wind direction, calm conditions and wind speed. NOAA weather maps are also

used to show that an upper level trough greatly influences the direction of the plume in relation to the East Central Indiana region.

Trajectory

Modeling: The NOAA HYSPLIT Models are used to show wind trajectories at different levels during this event. Backward modeling from the site (latitude: 40.20°; longitude: -85.39°) at elevations of 25m, 150m and 500m was conducted for a period of three (3) to four (4) days prior. The differing elevations were chosen to demonstrate the air mass's uniformity at ground-level where the samplers were located and aloft which avoids the ground-level limitations of the model. Forward modeling was conducted using the Bugaboo Scrub Fire as the starting point (latitude: 30.70°; longitude: -82.40°) at an elevation of 250 meters (appropriate height that is low enough to always be in the well-mixed zone and high enough to avoid the ground-level model limitation) and going three (3) to four (4) days. Overall, there is a very good correlation when comparing the forward and backward trajectories for a given date. For example, May 25 and 31 show a very narrow channel of air flow between southeastern Georgia and East Central Indiana. Both the backward and forward trajectories confirm this. Forward trajectory modeling results are shown in Appendix 2.

Conclusion: EPA defines an “exceptional event” as an unusual or naturally occurring event that can affect air quality but is not reasonably controllable by state and local agencies. Exceptional events are events for which the normal planning and regulatory process established by the clean air act is not appropriate. It has been illustrated through the use of maps, meteorological data, speciation data, trajectory models and historical data that the smoke from wildfires in Florida and Georgia impacted the East Central Indiana region during the period of May 23–25, 29-31, 2007 causing exceedances of the PM_{2.5} 24-hour standard and significantly increasing the annual average. According to 40 CFR Part 50.14 (b)(1), “EPA shall exclude data from use in determinations of exceedances and NAAQS violations where a State demonstrates to EPA’s satisfaction that an exceptional event caused a specific air pollution concentration in excess of one or more national ambient air quality standards at a particular air quality monitoring location and otherwise satisfies the requirements of this section.” IDEM believes they have successfully illustrated the impact of this event on the sites in this region.

Therefore, IDEM requests that EPA concur with the ‘E’ flag on the data in AQS for the data in **bold** in Table 6.1.

NOAA Satellite Smoke Maps, Weather Maps And Wind Roses

The smoke map shows that the plume has reached the east central Indiana region and as shown in Table 6.1, PM_{2.5} levels have started to increase. The corresponding wind rose and weather map further illustrate the direction of the plume by the location of the upper level trough (orange dashed line) and the S, SE prevailing winds.

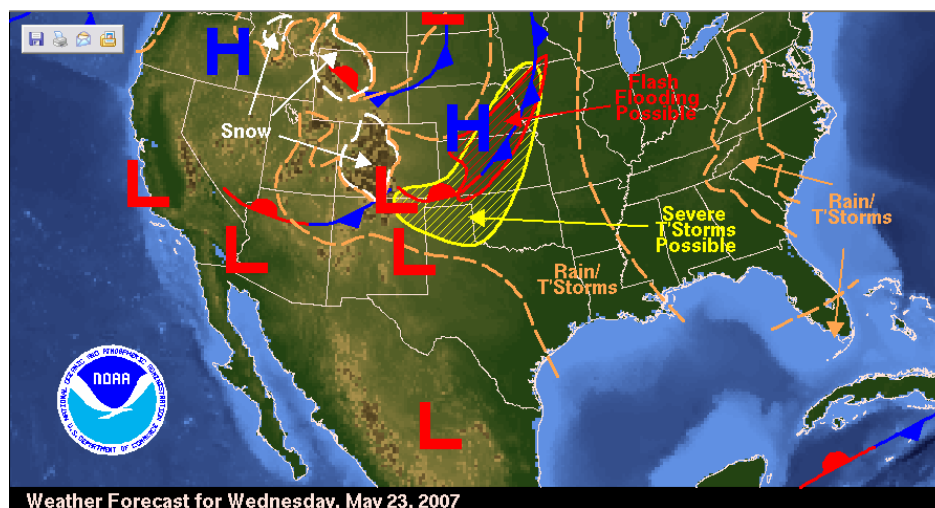
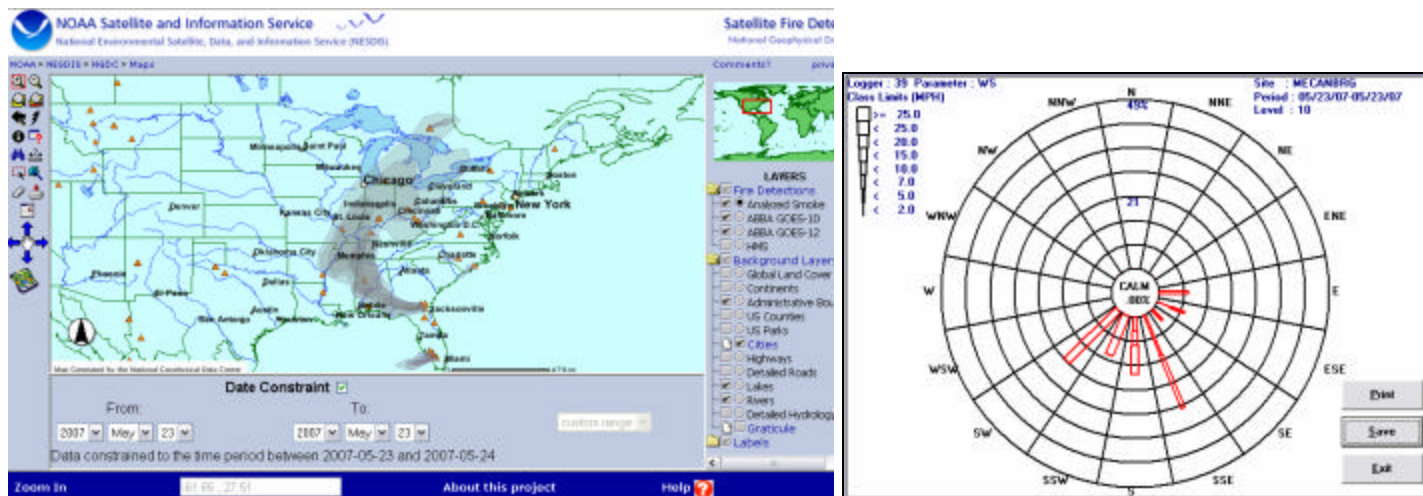


Figure 6.1 - May 23, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction has shifted to the SSW as the upper level trough moves further to the east and another trough develops over Ohio, keeping the plume over the central Indiana region.

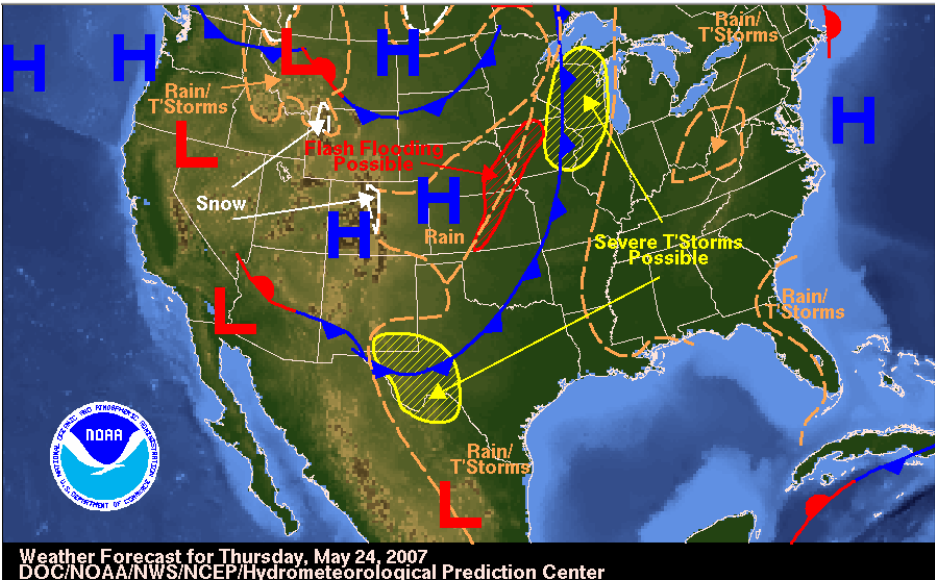
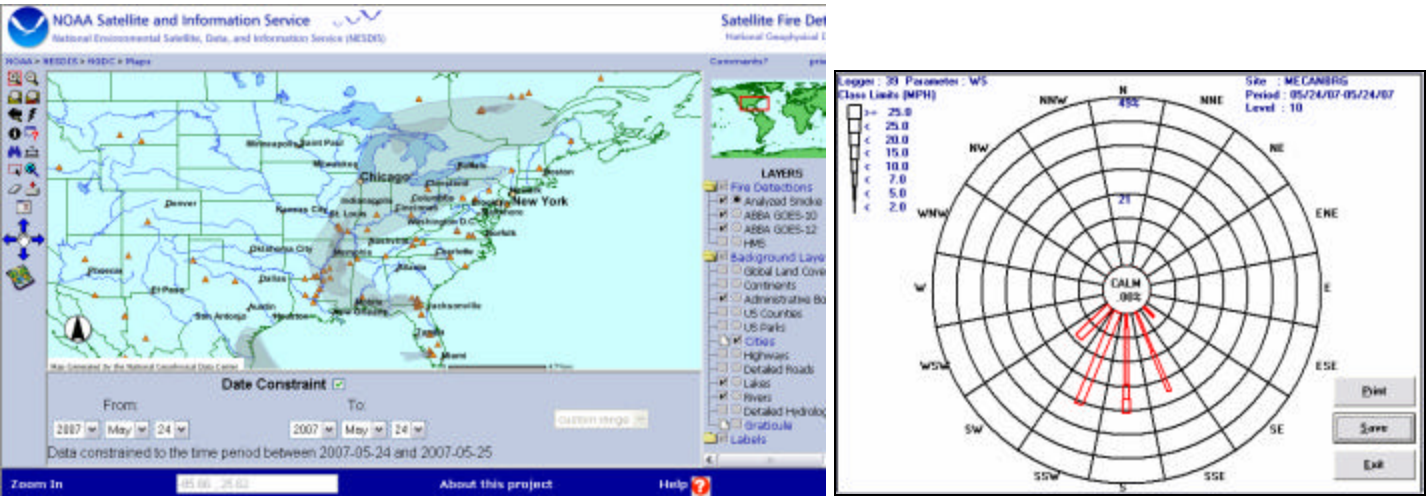


Figure 6.2 - May 24, 2007

The smoke map shows that the plume is remaining over the area. The prevailing wind direction continues to be from the SW as the upper level trough has now moved directly over the east central Indiana region.

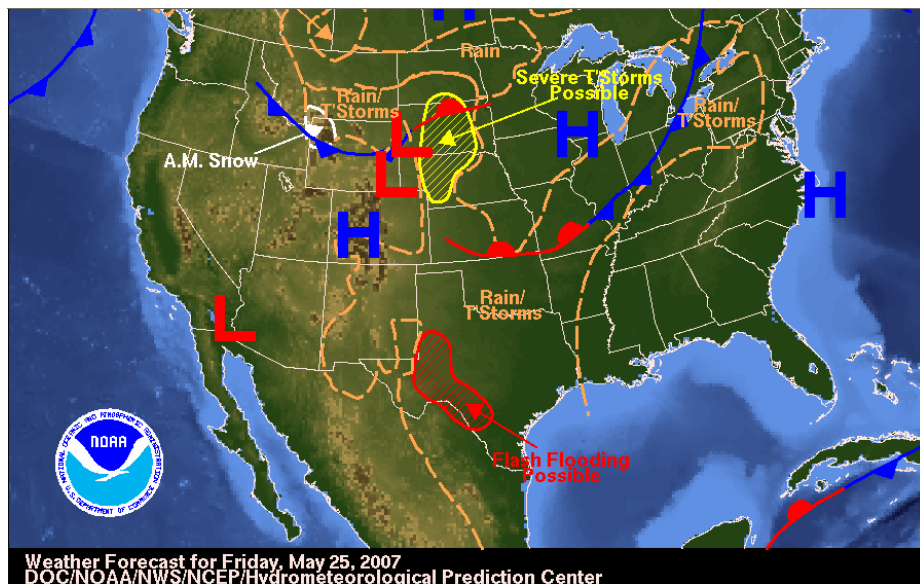
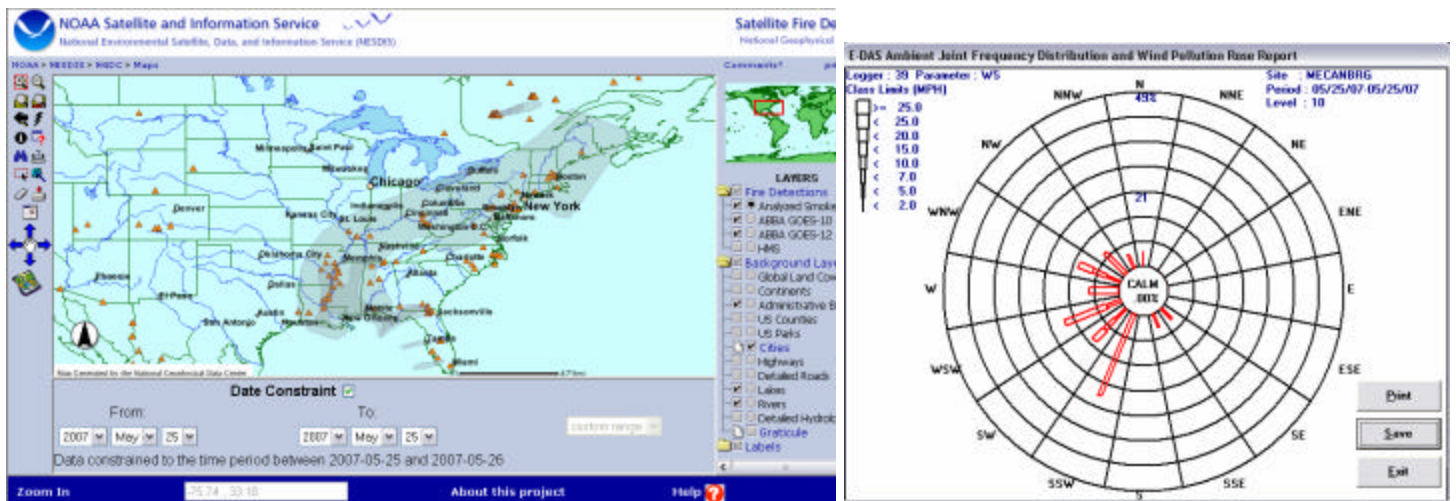


Figure 6.3 - May 25, 2007

Although the map illustrates the plume is not over the region, the prevailing SE wind direction, as shown by the wind rose, keep the high levels of PM_{2.5} over the area.

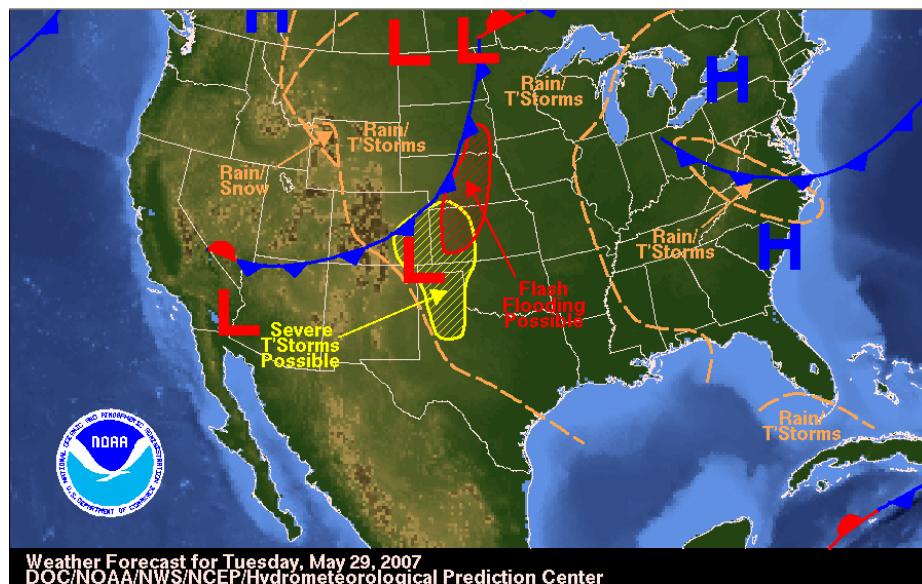
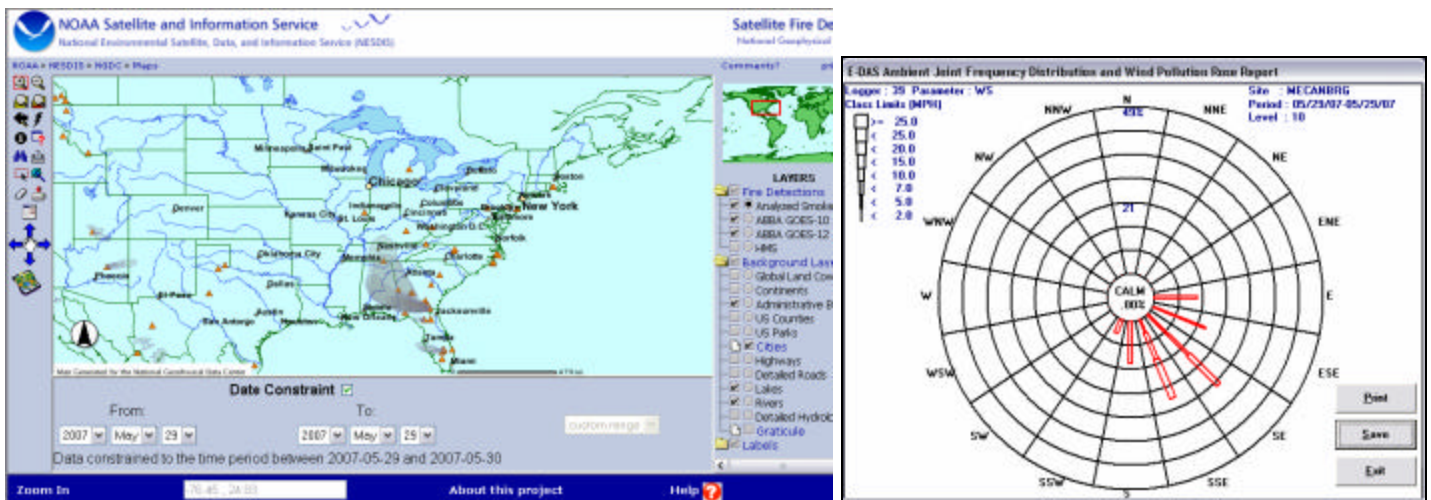


Figure 6.4 - May 29, 2007

The map shows the plume has moved back over the region as the upper level trough dips down over the area and the wind direction continues to be from the S, SE.

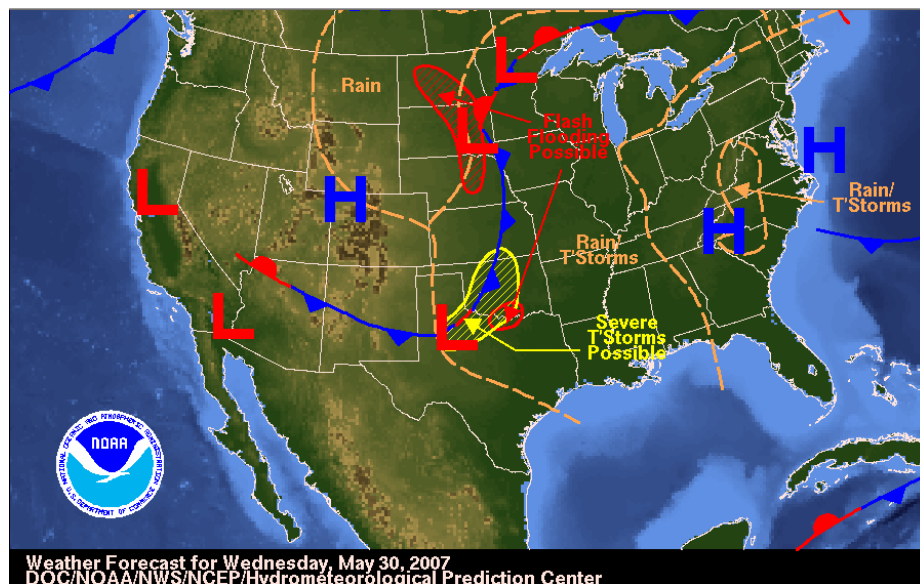
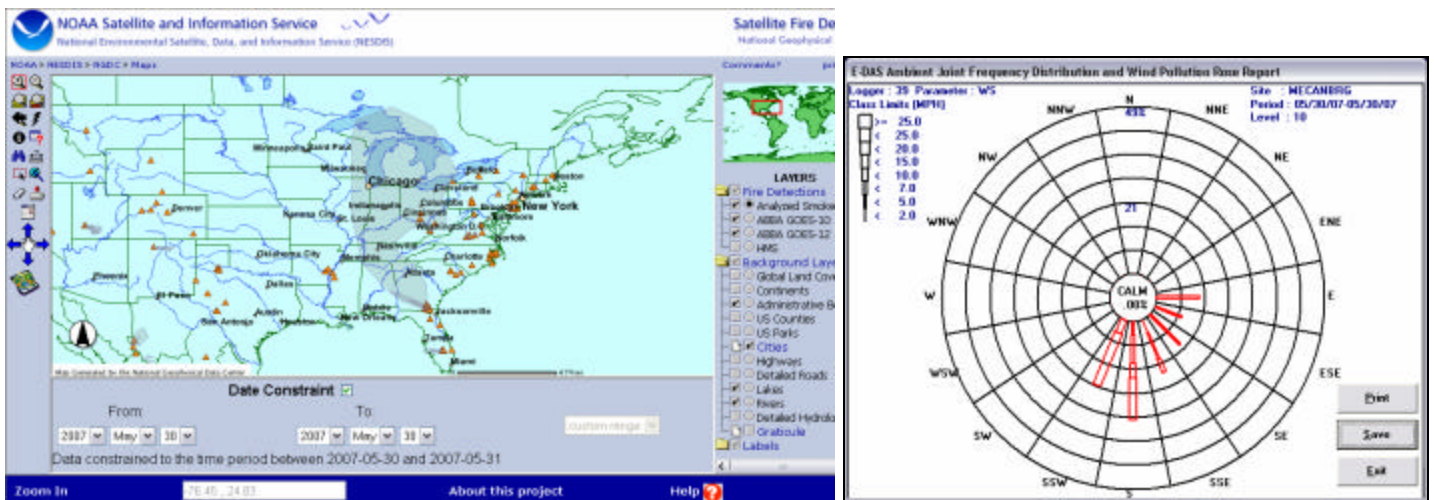


Figure 6.5 - May 30, 2007

The map shows the plume has dissipated as the upper level trough moves to the east, however, strong southerly winds continue to move high particulate levels into the area.

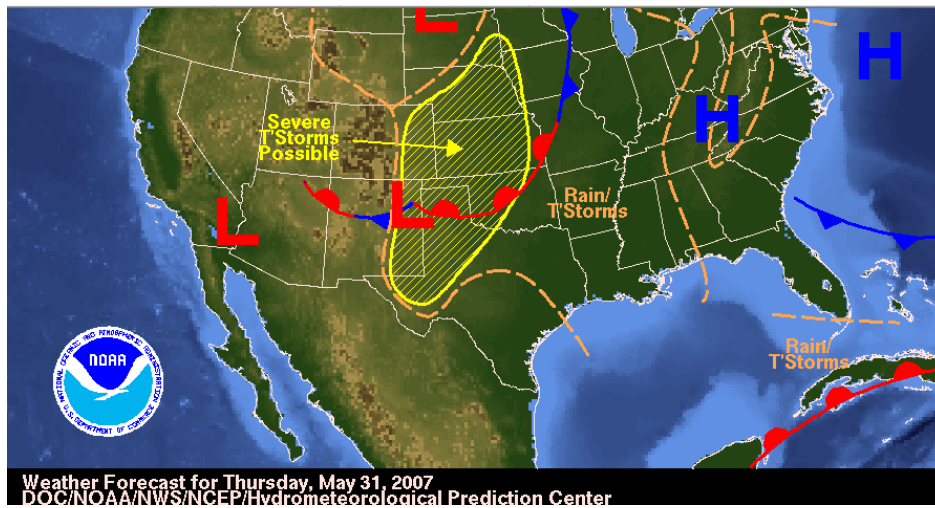
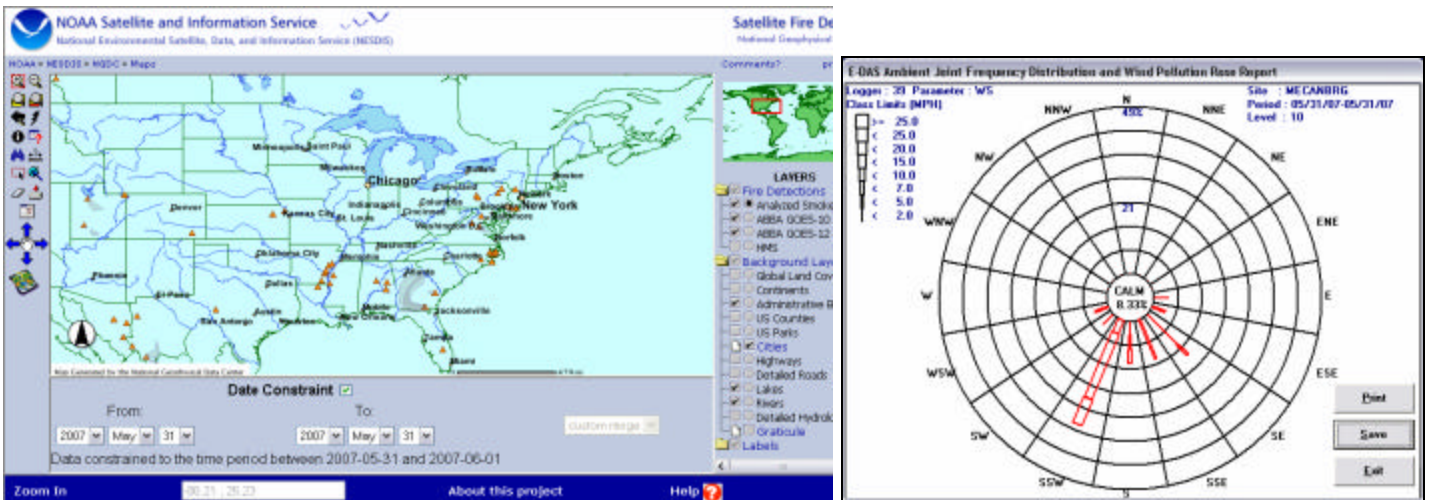


Figure 6.6 - May 31, 2007

Backward Trajectory Models

NOAA ARL READY HYSPLIT Maps

Draxler, R.R. and Rolph, G.D., 2003. HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) Model access via NOAA ARL READY Website (<http://www.arl.noaa.gov/ready/hysplit4.html>). NOAA Air Resources Laboratory, Silver Spring, MD.

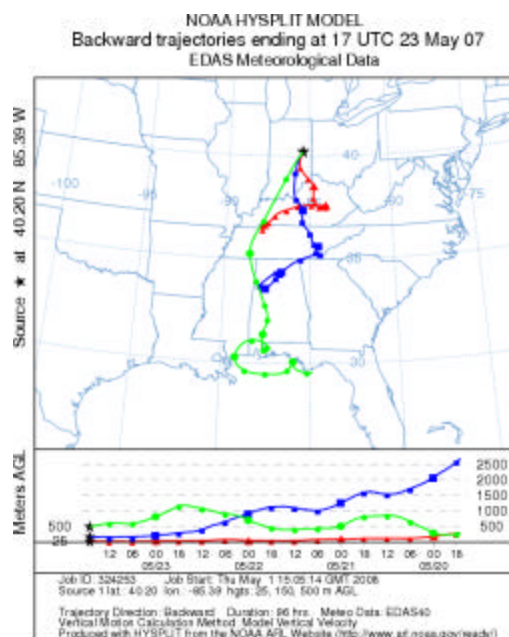


Figure 6.7: Backward trajectories originating from Muncie on 5/23/07 at 12:00 PM EST showing the air mass beginning to arrive from the South.

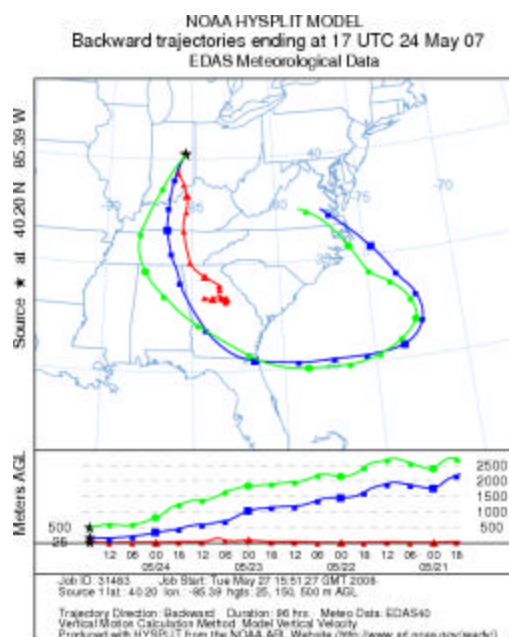


Figure 6.8: Backward trajectories originating from Muncie on 5/24/07 at 12:00 PM EST showing the air mass now passing over southern Georgia.

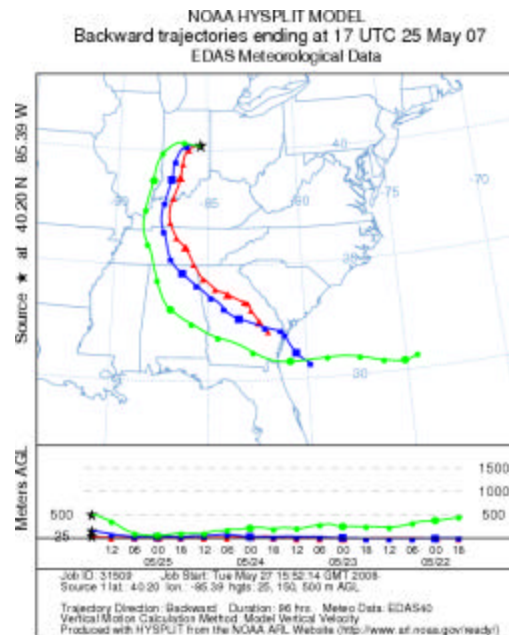


Figure 6.9: Backward trajectories originating from Muncie on 5/25/07 at 12:00 PM EST showing the air mass still passing over southern Georgia.

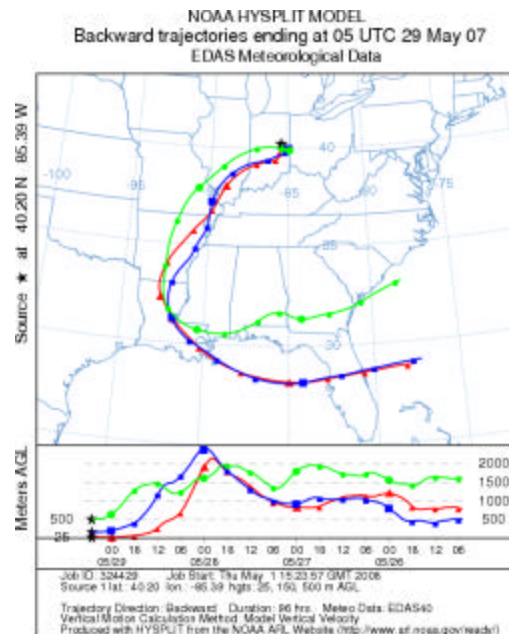


Figure 6.10: Backward trajectories originating from Muncie on 5/29/07 at 12:00 AM EST showing the air mass still passing over the Florida/Georgia region.

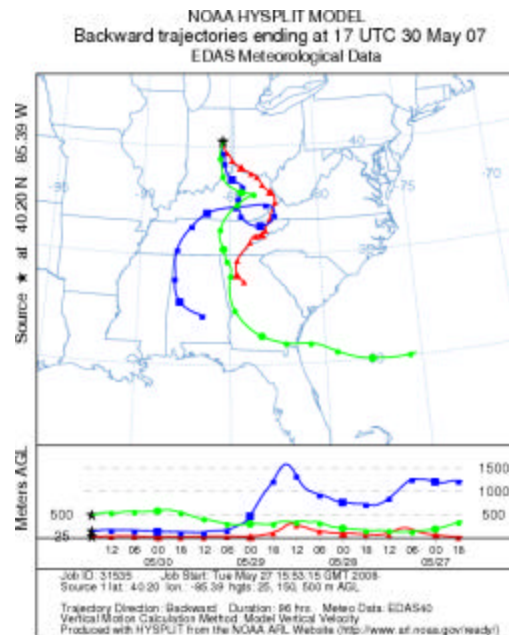


Figure 6.11: Backward trajectories originating from Muncie on 5/30/07 at 12:00 PM EST showing the air mass still arriving from Georgia.

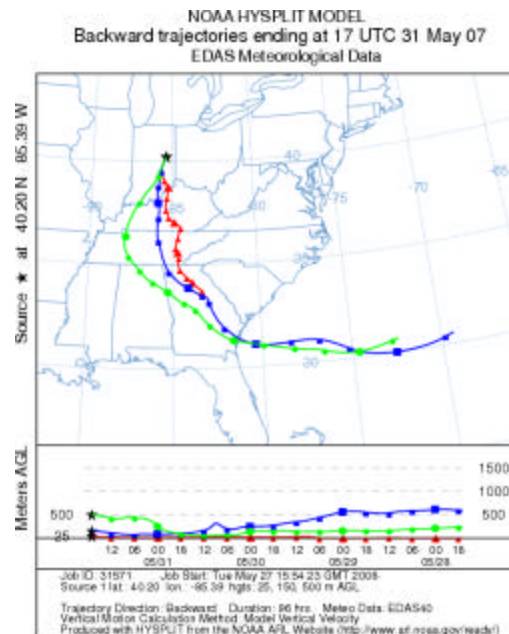


Figure 6.12: Backward trajectories originating from Muncie on 5/31/07 at 12:00 PM EST showing the air mass still arriving from southern Georgia.